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ABSTRACT

The profiles in this report present a snapshot of recent reform efforts in mathematics and science teacher education programs at institutions participating in Project SUSTAIN (Schools and Universities Statewide Teaching Approaches to Inquiry) collaboratives. Data were collected during the year 2000, and respondents were asked to describe developments over the past 3-5 years. Some of the initiatives were supported by SUSTAIN funding, and some were supported by other state, federal, and/or private funding. Because respondents could provide only information accessible to them, this report necessarily presents a conservative picture of the wide range of efforts underway throughout the state of Ohio to improve the preparation of mathematics and science teachers for the 21st century. (MM)

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ED 463 971

Milestones 2000

Reform Efforts in Mathematics and Science Teacher Education Programs at SUSTAIN Collaboratives in Ohio

Project SUSTAIN
The Ohio State University
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Foreword

The profiles in this report present a snapshot of recent reform efforts in mathematics and science teacher education programs at institutions participating in *Project SUSTAIN* collaboratives. Data were collected during the year 2000, and respondents were asked to describe developments over the past 3-5 years. Some of the initiatives were supported by *SUSTAIN* funding, and some were supported by other state, federal, and/or private funding. Because respondents could provide only information accessible to them, this report necessarily presents a conservative picture of the wide range of efforts underway throughout the state of Ohio to improve the preparation of mathematics and science teachers for the 21st century.

Our most sincere appreciation goes to the primary contact persons listed on the back of each profile, who provided most of the information recorded herein. Any errors are due to our interpretation, and not to the data they provided.

Sigrid Wagner
Steven P. Meiring
Kelly M. Costner

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Project SUSTAIN
Mathematics and Science Teacher Education

What Is Project SUSTAIN?

Project SUSTAIN (Schools and Universities Statewide Teaching Approaches to INquiry) is a multi-year effort funded by the Ohio Board of Regents and the Ohio Department of Education to foster collaboration within and among colleges and universities engaged in mathematics and science teacher education. The purpose of *SUSTAIN* is to expand and institutionalize improvements in the preparation and professional development of K–12 mathematics and science teachers to meet the challenges of the 21st century.

Goals of Project SUSTAIN

- Enhance student achievement in mathematics and science, particularly in urban and other at-risk districts, through college and university partnerships with schools;
- Improve preservice teacher preparation programs in mathematics and science by:
  a. Implementing standards-based approaches to teaching mathematics and science content courses;
  b. Improving links with in-service professional development; and
  c. Increasing the integration of content and pedagogy in teacher preparation;
- Strengthen coordination and communication among college faculties (Education and Arts & Sciences) to improve the teaching and learning of mathematics and science for preservice teacher education programs;
- Establish ongoing collaboration among institutions of higher education, school districts, and professional development centers with a focus on teacher preparation and professionalization.

Progress in Stages

- Phase 1 involved eight institutions in seven collaboratives that extended Project *Discovery* institutes to state-assisted universities moving to institutionalize standards-based, sustained professional development models for mathematics, physics, and life sciences.
- Phase 2 expanded to 12 state-assisted universities in redesign of preservice teacher education programs and in-service courses through intra-university collaborations between Arts & Sciences and Education.
- Phase 3 will encompass all 13 state-assisted universities, through inter-university collaborations with selected private and two-year colleges, in partnership with at-risk school districts, to expand and coordinate inquiry- and standards-based teacher preparation throughout a region.

Project Criteria

Projects funded must have potential for improving achievement and disposition for all students, especially those traditionally underrepresented in mathematics and science. Projects must demonstrate measurable and institutionalized improvements in preservice teacher education programs, such as:

- Developing new courses, programs, or models for teacher preparation; and/or
- Improving existing courses and programs by incorporating standards-based features of *Discovery*.

Desirable outcomes include enhancing the professional development of college and university faculty, promoting linkages between preservice and in-service professional development programs, or exchange of services between school and university campuses.

System Alignment

Improving the preparation of teachers in mathematics and science provides the impetus for realigning teacher education programs with national and state standards for content, teaching methods, and clinical field experiences. Content coursework needs to emphasize mathematical reasoning, problem solving, and the processes of scientific investigation. Students need to acquire content knowledge through the same intensive, inquiry experiences that standards-based methods courses recommend for K-12 students. Mentor teachers in clinical field experiences should model standards-based teaching practices.

For such system alignment to occur, coherent, coordinated, and collaborative partnerships must flourish among departments of science and mathematics, schools of education, school districts, and professional development centers. These partnerships must include all universities, community colleges, and private institutions of higher education in Ohio. Commonly shared understandings of inquiry- and standards-based teaching practices must become a reality at all educational levels throughout the state. Equivalent and consistent teacher training is a practical necessity for transfer students, as well as for equity in the quality of teachers who work with K-12 students anywhere in Ohio. Inter-institutional partnerships that enable professional growth for faculty, sharing of standards-based courses and programs, and an inter-linked system of technical support for teacher education are goals that *SUSTAIN* supports.

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Visit our website:
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Bowling Green State University
Mathematics and Science Education Profile

Institution

- 16,550 undergraduate students
- 2,750 graduate/professional students
- 720 faculty

Bowling Green State University, established in 1910, offers 200 degree programs in 15 schools and colleges.

Mathematics and Science Teacher Education

- 2 mathematics education faculty
- 2 science education faculty

Baccalaureate programs produce about 35 mathematics teachers and 35 science teachers (grades 7-12) each year. The number of students in mathematics and science education has remained steady for the past three to five years.

Course Development and Revision

- 5 new mathematics courses
- 3 mathematics courses revised
- 2 new mathematics methods courses
- New science course "Journey into Science"
- New chemistry course "Teaching in Chemistry Lab"
- Revision of "Environment of Life" course

Courses in Arts & Sciences and Education have been revised or developed to reflect new licensure requirements in middle childhood and early adolescent areas and to incorporate inquiry approaches.

Intra-Institutional Collaboration

- *SUSTAIN* collaboration between education and mathematics faculty
- National Science Foundation grant awarded to education and biology faculty
- National Science Foundation grant for professional development awarded to environmental science and physics faculty working with Toledo schools

Education and Arts & Sciences faculty work together extensively to revise courses and programs in order to meet new standards for middle grades licensure. Project Kaleidoscope involves eight faculty from science, mathematics, engineering, and technology collaborating to strengthen interdisciplinary education.

Inter-Institutional Collaboration

- Firelands College
- Owens Community College
- University of Findlay

BGSU education faculty are working with faculty from these institutions to develop deeper understanding of the mathematics needs of early childhood teachers. The plan is to allow each institution to revise its mathematics courses for early childhood majors and to meet as collaborating faculty regarding successes and challenges of implementing course revisions.

Institutes and Workshops for K-12 Teachers

- 4 Eisenhower institutes
- 1 NSF institute
- 1 OSI-*Discovery* institute
- Physics group collaboration on MAT program

Over the past 3-5 years, institutes have involved more than 350 local teachers and administrators. Primary engagement in the past year has been with the Findlay City Schools through a National Science Foundation project and *SUSTAIN* funding. Additional outreach programs to area teachers and administrators include Partners in Teacher Quality Success, a Teacher Preparation Summit, and ongoing collaboration among physics faculty and local high school physics teachers on a new MAT degree.

Professional Development for Higher Education Faculty

- 1 summer study group for faculty
- Brown bag science and mathematics education group

A study group of five mathematics educators from BGSU and three other higher education institutions met in summer 2000 to investigate the research on early childhood mathematics development. Thirty faculty from education, science, and mathematics meet monthly for professional dialogue regarding program improvement.

SUSTAIN Focus at Bowling Green State University

- 1998-99: Inquiry mathematics institute for 50 Findlay K-8 teachers and administrators. Included an undergraduate methods class of 27 students in collaboration with in-service teachers, attending evening sessions with teachers, and then doing field experiences with their partnering teachers.
- 2000-01: Conducting a collaborative study group of faculty from BGSU, Firelands College , Owens Community College, and University of Findlay for revising curriculum for early childhood majors. Developing two new inquiry-based mathematics courses, one for early childhood and one for middle childhood.

Bowling Green State University is using a two-pronged strategy, one involving institutes for teachers and the other, development of inquiry-based courses. The second activity entails collaborations among Education and Arts & Sciences faculties, as well as partnerships with other regional institutions.

Bowling Green State University SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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Owens Community College		Julie Grabowski	*Arts and Sciences*
University of Findlay		Anne Albert	*Mathematics*

Ohio's Systemic Initiative
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Central State University
Mathematics and Science Education Profile

Institution

- 1,104 undergraduate students
- 74 full-time faculty
- 25 master's students

Central State University, Ohio's only public historically black university, was established in 1887 and offers 40 degree programs across 3 colleges.

Mathematics and Science Teacher Education

- 4 mathematics faculty with 1 having primary responsibility for mathematics education
- 8 science faculty with 2 having primary responsibility for science education

Baccalaureate programs have produced 12 (11 African American) mathematics teachers (grades 7-12) and 6 (5 African American) science teachers (grades 7-12) since 1993. Central State awards about 60 percent of the mathematics education and about 33 percent of the science education degrees awarded to African American students at Ohio public universities each year. The number of students and faculty in mathematics and science has remained fairly constant over the past five years.

Course Development and Revision

All education (EDU) courses have been revised, with an emphasis on early (first year) field placement. As a result of support from *SUSTAIN*, many of the general education courses are being enriched with the themes of discovery, inquiry, and learning by doing.

Intra-Institutional Collaboration

- Arts & Sciences and Education faculty reviewed and revised all university programs and courses related to new teacher licensure requirements.
- A Minority Science Improvement Project (MSIP) grant supports infusion of general education courses with technology and provides ongoing support for collaboration.

SUSTAIN provides the impetus for continued dialogue and collaboration among Education and Science and Mathematics faculty.

Inter-Institutional Collaboration

- Illinois Institute of Technology
- Morgan State University
- Clark Atlanta University
- Texas Southern University
- Wright State University
- Cedarville University

Interactions with faculty and students at these universities have provided opportunities for mutual exchange of ideas and programs.

Institutes and Workshops for K-12 Teachers

- 1 science workshop for Yellow Springs High School students
- 1 interdisciplinary, mathematics and science hands-on project for Hickory Dale Elementary teachers
- 1 hands-on biology workshop for 144 elementary students from the Xenia Community Schools
- Three-week summer institute for high school students team-taught by Central State faculty and teachers from Dayton City Schools

Central State faculty make numerous presentations to and host programs for students and teachers from area schools. These include special media prepared for AP biology coursework, garden shows for elementary and middle school students, development of a youth garden for Jefferson Montessori Elementary School, and a one-day enrichment program in mathematics and science for Dayton City high school students.

Professional Development for Higher Education Faculty

- Project Kaleidoscope (PKAL) Faculty for the 21st Century Network
- Participation Strategies for Successful Classroom Interaction, a science education workshop sponsored by Sinclair Community College and Benjamin Cummings

A fully staffed university office of faculty development is a clearinghouse for numerous internal and external opportunities for faculty development.

SUSTAIN Focus at Central State University

- 1998-99: Participation by Central State faculty in inquiry-based teaching workshops for faculty conducted by the Wright State University *SUSTAIN* project.
- 2000-02: Membership in the five-institution Miami Valley Regional Collaborative for the Improvement of Science and Mathematics Education through inquiry-based teaching.

Project SUSTAIN has afforded faculty opportunities to interact with peers from nearby institutions resulting in the Miami Valley Regional Collaborative project for 2000-02. More than 30 faculty from five institutions are working collaboratively on science and mathematics course and program enhancement, ongoing faculty professional development, and technology projects to develop methods of dissemination. These activities provide a continuing forum to discuss discipline-specific interests, resulting in substantive and meaningful improvements in teaching, learning, and teacher education at Central State University.

Central State University SUSTAIN Collaborative Directory

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		Subramania Sritharan	*Water Resources Management*

Ohio's Statewide Initiative
Discovery

Cleveland State University
Mathematics and Science Education Profile

Institution

- 11,340 undergraduate students
- 5,170 graduate/professional students
- 542 faculty

Cleveland State University, established in 1964, offers over 117 undergraduate and 40 graduate degree programs across 9 colleges and schools.

Mathematics and Science Teacher Education

- 2 mathematics education faculty
- 4 science education faculty
- 1 visiting mathematics education faculty

Baccalaureate and graduate programs produce about 15 mathematics teachers and 13 science teachers (grades 7-12) each year. The number of teachers prepared each year generally has been fairly constant.

Course Development and Revision

- Separate methods courses for middle and early childhood specialization in mathematics and science
- Practicum added for middle childhood and secondary science and mathematics licensure areas
- New courses developed in Physical Science and Outdoor Science for middle childhood
- Science course under development for all education majors (P-12); taught by Arts & Sciences faculty

All courses at Cleveland State University have been revised to accommodate conversion to semesters. This has provided the opportunity to infuse inquiry-based approaches, as needed, as well as historical and social perspectives, problem solving, and authentic assessment.

Intra-Institutional Collaboration

- Joint proposals with the Environmental Center (2 proposals funded and 3 pending)
- Cooperative programs between faculties in the Colleges of Arts & Sciences and Education

An example of cooperative programming is the development of a pilot 3-hour shadow course in geology focusing on inquiry, pedagogy, and integration of mathematics and science.

Inter-Institutional Collaboration

- Case Western Reserve University
- Joint grant with John Carroll University
- Professional development seminar implemented with Great Lakes Science Center

Other examples are collaborations with the Cleveland Botanical Gardens, cooperative programs with Urban Initiative Schools (Cleveland, Cleveland Heights-University Heights, East Cleveland, Euclid, Parma).

Institutes and Workshops for K-12 Teachers

- 2 principals' institutes for the *Discovery* program in Cleveland
- *Project Discovery* institutes on campus for the last three years
- FAST Institute for Cleveland Heights-University Heights Schools

Outreach also includes work with the Jewish Education Center of Cleveland, Lorain County teachers, SMART Consortium districts, and technology institutes for mathematics and science teachers.

Professional Development for Higher Education Faculty

- 2 inquiry methods colloquia for faculty in the Colleges of Arts & Sciences and Engineering
- "Inquiry into Inquiry" for Arts & Sciences faculty to experience and develop inquiry strategies
- Development of inquiry course in geology; development of web-based geology course

Professional development for higher education faculty occurs formally through colloquia focused on inquiry methods of teaching and related course development, as well as informally through participation by faculty from Arts & Sciences and Education in students' preservice field experiences.

SUSTAIN Focus at Cleveland State University

- 1997-98: Bridging prior inquiry training of Cleveland Public teachers through new institutes to train implementation and professional development teams for an inquiry-based integrated science and mathematics curriculum in the middle schools.
- 1998-99: Continuation of FAST curriculum implementation involving grades 6-8 teachers and practicum experiences with preservice students.
- 1999-00: Twenty Arts & Sciences faculty members engaged in 5 seminars to explore inquiry pedagogy and model lessons while experimenting with their own classes.

The Cleveland State University approach is to move preservice training closer to the school site, enabling field experience and student teaching in inquiry classrooms, through participation of Education and Arts & Sciences faculty. It also entails expansion of inquiry training from *Discovery* teachers in Cleveland Public Schools to other staff, and implementation of an inquiry-based curriculum in the middle grades.

Cleveland State University SUSTAIN Collaborative Directory

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Case Western Reserve University		Mano Singham	*Physics*
John Carroll University		Linda Gojak	*Education*
		Jerry Moreno	*Mathematics*

Ohio's Statewide Initiative
Discovery

Kent State University
Mathematics and Science Education Profile

Institution

- 17,300 undergraduate students
- 4,400 graduate students
- 616 faculty

Kent State University, founded in 1910, offers nearly 170 bachelor's degree programs across 8 colleges. The master's degree is offered in 37 programs, and there are 20 areas of specialization for the doctorate.

Mathematics and Science Teacher Education

- 3 full-time mathematics education faculty
- 1 half-time mathematics education faculty
- 1 full-time science education faculty
- 2 half-time science education faculty

Baccalaureate programs produce about 18 mathematics teachers and 30 science teachers (grades 7-12) each year. The number of students in mathematics education has decreased slightly in recent years, while the number in science education has increased slightly.

Course Development and Revision

- 2 new mathematics courses
- 2 new science courses for middle grades
- 1 additional mathematics course and 1 methods course will be developed in 2000-01

Kent State is focusing upon content courses that satisfy requirements for both middle childhood and adolescent licensure. These courses are being developed collaboratively by Arts & Sciences and Education.

Intra-Institutional Collaboration

- Mathematics and mathematics education faculty members team teach courses for preservice teachers
- Collaborative planning of a joint mathematics/mathematics education master's degree
- NSF-funded "KSU Teaching Fellows Partnership with Teachers in Science and Mathematics Education"
- Collaborative planning of teacher preparation programs for middle childhood and adolescent licensure

Arts & Sciences and Education faculty have been engaged for several years in planning and designing content and education course sequences for middle childhood and adolescent teacher licensure.

Inter-Institutional Collaboration

- Collaboration with faculty of branch campuses
- Informal information exchange sessions with faculty at the University of Akron

Grant proposals, in-service teacher education, project assessments, and future collaboration topics are being coordinated between mathematics faculty of the main and branch campuses of Kent State. Members of the science and mathematics education faculties of Akron and Kent State have met to discuss research interests, grant work, new program goals, and issues and problems in teacher education.

Institutes and Workshops for K-12 Teachers

- Workshop with 45 secondary mathematics mentor and novice teachers
- Curriculum project with Kent City schools
- Physics faculty provides school demonstrations and training of teachers to give peer workshops

Five mathematics and science education faculty members are very active in providing leadership and service to area school districts, including Ashland County, Mentor City, and Kent City districts. In addition to workshops and institutes, faculty are engaged in numerous research projects with area schools and in enlisting teachers in peer professional development.

Professional Development for Higher Education Faculty

- 2 colloquium series for faculty

The colloquium series for mathematics faculty in 1999-2000 included presentations by researchers in inquiry teaching and undergraduate mathematics teaching. One of these researchers will conduct a series of colloquia on pedagogy in the fall of 2000. Two other distinguished speakers will also present colloquia.

SUSTAIN Focus at Kent State University

- 1998-99: Two major colloquia for 25 mathematics faculty led by national experts on inquiry research and undergraduate mathematics teaching.
- 1999-00: Two undergraduate and corresponding graduate content courses for middle childhood and adolescent licensure revised and team taught to 120 students as part of a research study.
- 2000-01: One additional content course for middle childhood/adolescent licensure and one new methods course for middle childhood licensure, as well as graduate course analogs, will be revised.

Kent State University is taking a scientific, research-based approach to revising mathematics content courses for middle childhood and adolescent licensure. World-class experts are engaging mathematics faculty in studying the research effects on students' learning of inquiry-based teaching.

Kent State University SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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Ohio's Systemic Initiative
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Miami University
Mathematics and Science Education Profile

Institution

- 14,800 students
- 1,300 graduate students
- 890 faculty

Miami University, founded in 1809, offers more than 100 bachelor and associate degree programs across 7 colleges and schools. The master's degree is offered in more than 50 programs; there are 9 doctoral programs.

Mathematics and Science Teacher Education

- 2 full-time mathematics education faculty
- 6 science education faculty
- 2 part-time mathematics education faculty

Each year baccalaureate programs produce about 40 mathematics teachers and 24 science teachers (grades 7-12), 24 mathematics teachers and 12 science teachers (grades 4-9), 20 elementary teachers (grades 1-8) with concentrations in mathematics, and 10 elementary teachers (grades 1-8) with concentrations in science.

Course Development and Revision

- 62 new science, mathematics, and education courses; 2 additional new courses pending
- 24 revised science, mathematics, and education courses; 2 additional course revisions pending

Engagement with *Project Discovery* has been a stimulus for faculty in Arts & Sciences and Education to revise programs to incorporate more inquiry. Another major development is a new Master of Arts in Teaching program for life science teachers funded by a grant from the Howard Hughes Medical Institute.

Intra-Institutional Collaboration

- Project Esteem minority student support program
- Title II grant to the Department of Mathematics and Statistics to develop a new middle childhood course

Collaboration among Arts & Sciences and Education faculty occurs regularly on programs, grants, and teacher workshop planning/delivery. One such summer program works with university minority students to enhance their mathematics and science abilities and to build their self-esteem in mathematics and science.

Inter-Institutional Collaboration

- College of Mount Saint Joseph
- Xavier University
- *Project Discovery* development, administration
- Project Dragonfly journal for children and teachers
- Life science departments partnership with the Cincinnati Academy of Mathematics and Science

Miami University has been a co-leader with The Ohio State University in developing and coordinating *Project Discovery* and OSI-*Discovery*, providing mathematics and science leadership for statewide reform efforts through teacher and leadership institutes and related follow-up research.

Institutes and Workshops for K-12 Teachers

- More than 40 credit workshops scheduled annually by Arts & Sciences and Education departments
- 20 additional workshops by Center for Chemistry Education funded by NSF, Eisenhower, and NIH
- Annual collaborative field-site science camps in Wyoming for teachers
- Molecular Biology and Recombinant DNA Institutes for high school teachers for the past nine years

University departments collaborate with area school districts on various projects for students and teachers, including a mathematics-science-engineering project, LegoMindstorms Robotics Teams, and Project Green; and 20 workshops per year for teachers through science themes such as Teaching Science With Toys, Integrating Science and Literature, and Science is FUN.

Professional Development for Higher Education Faculty

Two day-long retreats have been held for science and mathematics education faculty from six science departments, mathematics, and teacher education. Workshops were presented by experts in science and mathematics education on topics related to the development of "ideal" science and mathematics teacher preparation programs, focusing especially on middle grades. These retreats were followed by extensive faculty task force development work in science and mathematics education.

SUSTAIN Focus at Miami University

- 1997-98: Used a collaborative approach with Arts & Sciences and Education faculty and regional teachers to develop proposals for new middle childhood licensure programs.
- 1998-00: Several new science and mathematics content courses and methodology courses field tested as requirements of new teacher licensure programs, two additional courses being developed.

Miami University has engaged in an inter-institutional collaboration with the University of Cincinnati in the design of new licensure programs in science and mathematics for the middle grades. Arts & Sciences and Education faculties have formed teams, including veteran teachers from the region, in the development of these new programs.

Miami University SUSTAIN Collaborative Directory

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Ohio's Statewide Initiative
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The Ohio State University
Mathematics and Science Education Profile

Institution

- 42,600 undergraduate students
- 12,400 graduate/professional students
- 2,970 faculty

The Ohio State University, established in 1870, offers over 176 undergraduate, 122 graduate, and 98 doctoral and professional programs across 19 colleges.

Mathematics and Science Teacher Education

- 3 full-time mathematics education faculty
- 1 half-time mathematics education faculty
- 4 full-time science education faculty
- 1 half-time science education faculty

The M.Ed. program produces about 15-20 mathematics teachers and 25-35 science teachers (grades 7-12) each year. In the last 5 years, the number of mathematics teachers prepared each year has declined about 25% while the number of science teachers has increased about 50%. The number of faculty has decreased by 2.5 positions in each area.

Course Development and Revision

- 2 mathematics content and 2 biology content courses for prospective teachers revised for inquiry
- 3 new inquiry-based physics courses for prospective teachers

M.Ed. methods courses are all inquiry-based, integrating mathematics, science, and technology education. A current focus is developing inquiry-based content courses that prospective teachers take as undergraduates.

Intra-Institutional Collaboration

- OSU was a development site for *Discovery* training of teachers and higher education faculty
- Joint development of M.Ed. courses and Arts & Sciences courses for prospective teachers
- Collaborations of Arts & Sciences and Education faculty on an international RISE Conference

Arts & Sciences and Education faculty collaborated in the development of the original *Discovery* in-service teacher institutes, replicated across Ohio. Similar collaboration involving mathematics, physics, biology, and education faculty has been ongoing in the development and revision of courses for preservice teachers.

Inter-Institutional Collaboration

- *Project Discovery* and OSI-*Discovery* development and administration
- *SUSTAIN* programs coordinated for state-assisted and private universities
- Columbus Urban Systemic Initiative

The Ohio State University has been a co-leader with Miami University in developing and coordinating *Discovery* activities across Ohio, including *Project SUSTAIN* programs for preservice teacher education.

Institutes and Workshops for K-12 Teachers

- 1 principals' institute
- 2 teacher institutes for Columbus City and South-Western City Schools
- CGI and T-cubed workshops

Education and Arts & Sciences faculty engage in a broad range of workshops and institutes that encompass leadership statewide, for example, Cognitively Guided Instruction for elementary mathematics teachers and Teachers Teaching with Technology, a national program focused on graphing calculators and other utilities.

Professional Development for Higher Education Faculty

- Pilot training for GAs and faculty interested in inquiry approaches to biology teaching
- Seminar course for GAs and faculty interested in issues related to science education
- The Redesign in Science Education Conference (RISE) in 2000

The RISE Conference, a professional development opportunity for faculty, K-12 teachers, and representatives of professional societies, featured several national and international speakers.

SUSTAIN Focus at The Ohio State University

- 1997-98: After-school institutes on the use of inquiry approaches integrating mathematics and science topics with the use of technology.
- 1998-99: Mathematics 105 and 106 revised to reflect inquiry-based teaching methods in large lecture courses taken by prospective elementary teachers.
- 2000-01: Biology 101 and 102 institutionalized as inquiry-based introductory sequence of courses taken by prospective elementary teachers.

Ohio State University offers only a fifth-year M.Ed. program for licensure of teachers. Efforts have centered upon collaborative revision and development by Arts & Sciences and Education faculties of inquiry-based courses, as well as statewide coordination of *SUSTAIN* collaborative and evaluation activities.

The Ohio State University SUSTAIN Collaborative Directory

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Ohio's Systemic Initiative
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Ohio University
Mathematics and Science Education Profile

Institution

- 16,200 undergraduate students
- 2,800 graduate/professional students
- 787 faculty

Ohio University, founded in 1804, offers 276 degree programs across 11 colleges and centers.

Mathematics and Science Teacher Education

- 4 mathematics education faculty
- 2 science education faculty

Baccalaureate programs produce about 20 mathematics teachers and 24 science teachers (grades 7-12) each year. The number of students in mathematics and science education has been fairly stable and is predicted to remain so for the next few years.

Course Development and Revision

- 6 courses developed for an interdisciplinary MA for experienced mathematics and science teachers
- 6 mathematics courses revised to incorporate writing, manipulatives, and computers
- Basic mathematics courses moving to computer-based instruction

Seven courses for the interdisciplinary MA are in various stages of development. Courses are designed during the academic year, piloted during the summer, and developed into full-fledged graduate courses the following two years. The process is expected to be completed in 2002.

Intra-Institutional Collaboration

- Developing an interdisciplinary MA consisting of courses both in Education and Arts & Sciences
- Increased communication between deans of the Colleges of Arts & Sciences and Education
- 5 National Science Foundation proposals submitted by collaborative groups across colleges

Ohio University is designing an interdisciplinary master's degree that will better serve practicing teachers. The program will include both content courses and pedagogy components; it will combine the best features of the traditional MA in the content area and the MS in education.

Inter-Institutional Collaboration

- Appalachian Rural Systemic Initiative (ARSI)
- South Regional Professional Development Center

Ongoing partners in Ohio University's *SUSTAIN* collaborative are the South Regional Professional Development Center and the Appalachian Rural Systemic Initiative. Teachers and instructors from the summer 1999 pilot project will present seminars at area 2-year community colleges and private colleges and establish relationships for more formal collaboration in the next phase of *SUSTAIN*.

Institutes and Workshops for K-12 Teachers

- 2 mathematics institutes
- 2 science institutes
- 2 mathematics and science institutes
- 31 teachers from 11 counties involved in 1999

Follow-up sessions throughout the academic year help participants implement inquiry-based lessons and provide time for critiques using videotapes from their classrooms.

Professional Development for Higher Education Faculty

- 2 institutes for mathematics faculty

Professional development of faculty has occurred in conjunction with institutes. Ohio University professors have participated as IHE participants in inquiry-based institutes for teachers and then as presenting faculty in Eisenhower- and *SUSTAIN*-funded programs sponsored for the South Region by the South Regional Professional Development Center and the Appalachian Rural Systemic Initiative.

SUSTAIN Focus at Ohio University

- 1998-00: Two courses collaboratively developed and taught each of three years (six in all). Courses revised according to summer institutes with in-service teachers (31 teachers from 12 high schools), field application of training by in-service and preservice teachers, and input by advisory teams of teachers, faculty, and ARSI representatives.
- 2000-02: Courses added to the framework for a new master's degree program; work to be extended collaboratively with other higher education institutions in the region. Participating faculty expected to revise other courses they teach according to inquiry approaches.

The new master's program (Arts & Sciences and Education) is the vehicle for institutional reform and for collaboration across the university, as well as with other higher education institutions in the region.

Ohio University SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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		Edwina Campbell	*SRPDC and Appalachian RSI*
		Al Cote	*SRPDC and Appalachian RSI*

Ohio's Systemic Initiative
Discovery

Shawnee State University
Mathematics and Science Education Profile

Institution

- 3,500 undergraduate students
- 131 faculty

Shawnee State University, created in 1986 from a former community college, offers 80 bachelor and associate degree programs across 2 colleges.

Mathematics and Science Teacher Education

- 1 mathematics education faculty
- 1 science education faculty

Baccalaureate programs produce about 5 mathematics teachers and 5 science teachers (grades 7-12) each year. The number of students in mathematics and science education has increased slightly over the past three to five years.

Course Development and Revision

- 3 new mathematics courses
- 5 mathematics courses revised to incorporate more inquiry
- 4 new science courses
- 6 science courses revised to incorporate more inquiry
- 5 new courses in mathematics and/or science education

Shawnee State has completed a full revision of teacher education programs and courses to meet new licensure requirements and has implemented a full teacher education conceptual framework for its new programs.

Intra-Institutional Collaboration

- Collaboration between Arts & Sciences and Education faculty in developing preservice courses for teachers and in conducting workshops for in-service teachers
- Campus-wide participation in NCATE review
- Physics faculty teach "Physics by Inquiry"

Education and Arts & Sciences faculty have worked together extensively to revise courses and programs in order to meet new licensure standards. Arts & Sciences faculty serve as instructors in *SUSTAIN* institutes.

Inter-Institutional Collaboration

- Portsmouth City Schools
- South Regional Professional Development Center

Shawnee State has a strong working partnership with the SRPDC in determining professional needs of South Region teachers, devising programs and institutes to meet those needs, and supporting teachers in these programs.

Institutes and Workshops for K-12 Teachers

- Annual Teacher Academy with 2–3 mathematics/science programs per year

National curriculum project materials and methods, most notably Cognitively Guided Instruction (CGI), Connected Mathematics Project (CMP), and Foundational Approaches in Science Teaching (FAST), are integrated into workshops for teachers.

Professional Development for Higher Education Faculty

Professional development of faculty has occurred in conjunction with OSI-*Discovery* and *Project SUSTAIN* institutes. Shawnee State professors have attended, as higher education participants, inquiry-based *Discovery* institutes for teachers and then conducted, as presenting faculty, *SUSTAIN*-funded programs sponsored for the South Region by Shawnee State University.

SUSTAIN Focus at Shawnee State University

- 1998-99: Collaboration of Arts & Sciences and Education faculties to deliver institutes to 80 Portsmouth City School teachers and preservice teachers. In-service and preservice teachers participate in institutes as a team, with the preservice teachers assigned to their in-service teammate for student teaching in the subsequent quarter.
- 1999-00: Shawnee State has developed seven new inquiry-based content courses for prospective mathematics and/or science teachers K-12 and has revised eleven other courses to incorporate more inquiry.

Shawnee State University has completed development of a core of inquiry-based courses for prospective teachers. They are continuing to refine that core through collaborations between Arts & Sciences and Education faculty working with area teachers and preservice students.

Shawnee State University SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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Ohio's Systemic Initiative
Discovery

University of Akron
Mathematics and Science Education Profile

Institution

- 19,426 undergraduate students
- 3,964 graduate/professional students
- 733 faculty

The University of Akron, founded in 1870, offers 311 degree programs across 12 colleges and schools.

Mathematics and Science Teacher Education

- 2 mathematics education faculty (each half-time)
- 2 science education faculty (1 full-time, 1 part-time)

Baccalaureate programs produce about 8 mathematics teachers and 10 science teachers (grades 7-12) each year. The number of students in mathematics and science education has held steady over the past five years, but each area has lost one faculty position.

Course Development and Revision

- 1 new mathematics course developed for elementary and middle grades preservice teachers
- 1 new science course developed for elementary and middle grades preservice teachers
- 4 science courses revised to incorporate more inquiry

These courses were developed or modified in Summer 1999 and will be offered in Autumn 2000. Efforts included production of modules, units, and activities for the courses, as well as an internal review of new and existing courses to determine alignment with state and national standards.

Intra-Institutional Collaboration

- Collaboration among Education and Arts & Sciences faculty for course revisions, licensure program development, and 3 grant proposals (1 state level and 2 national level)
- 4 meetings (average attendance 39 faculty, including department chairs and deans) to strengthen communication and coordination among faculties engaged in teacher education

SUSTAIN-funded Project TEAMS (Teacher Education at Akron for Mathematics and Science) serves as a primary facilitator of collaboration. Participants include faculty across 7 disciplines in arts & sciences and others from engineering and education, all of whom teach courses for elementary and middle grades preservice teachers.

Inter-Institutional Collaboration

- Baldwin-Wallace College
- Cuyahoga Community College
- Muskingum College
- Kent State University—Stark
- Malone College
- Oberlin College
- Wayne College
- Towson College

A 3-day chautauqua on inquiry learning, assessment techniques, and curriculum development conducted by Project TEAMS was attended by 23 faculty from 4 partner institutions in the northeast region of Ohio.

Institutes and Workshops for K-12 Teachers

- 3 teacher institutes
- 6 school districts

In the past year Project TEAMS has sponsored two workshops and a 2-day symposium on inquiry teaching and learning for middle grades and high school teachers from at least six school districts in the Akron/Canton area. University faculty and administrators also attended these institutes.

Professional Development for Higher Education Faculty

- 4 brown-bag programs
- 2 extended symposia

Project TEAMS has conducted several professional development experiences focusing on trends and issues related to college teaching and learning. An outgrowth of these activities is the formation of a task force on teacher education across the Colleges of Arts & Sciences, Education, Engineering, and Fine & Applied Arts.

SUSTAIN Focus at University of Akron

- 1997-98: Physics by Inquiry academic year institute co-taught by former *Discovery* teachers and university faculty to Akron Public Schools in-service teachers and University of Akron preservice teachers.
- 1998-99: Revision of 4 and creation of 2 new teacher education courses for elementary and middle grades licensure; professional development for university administration and faculty; inquiry content workshops for teachers from 6 Summit and Stark County school districts.
- 2000-02: Proposed creation of an Akron Center for Mathematics and Science Inquiry to support higher education institutional change in mathematics and science content and teacher education courses, including partnerships with 6 private and 5 two-year colleges.

Institutional support for faculty growth and rapid scaling up of inquiry-based teacher education characterize the University of Akron approach to mathematics and science education reform.

University of Akron SUSTAIN Collaborative Directory

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Ohio's Systemic Initiative
Discovery

University of Cincinnati
Mathematics and Science Education Profile

Institution

- 26,100 undergraduate students
- 7,566 graduate students
- 2,170 faculty

The University of Cincinnati, established in 1870, offers over 200 undergraduate degree programs and 140 graduate degree programs across 17 colleges and schools.

Mathematics and Science Teacher Education

- 4 mathematics education faculty
- 4 science education faculty

Baccalaureate and fifth-year programs produce 2-5 mathematics teachers and 10-14 science teachers (grades 7-12) each year. The number of mathematics teachers prepared has dropped from a previous average of 12 per year; the number of science teachers prepared has not changed.

Course Development and Revision

- 2 science courses have been revised: "Biology in Human Context" and "Geology for Teachers"
- 1 new biology course has been created for elementary teachers
- 4 new support courses have been created, two in mathematics and two in science

Course development and revision have been guided by faculty experiences in conducting inquiry-based institutes and workshops with teachers, drawing upon nationally validated projects and materials.

Intra-Institutional Collaboration

- 4 "shadow" courses for mathematics and science developed collaboratively
- Arts & Sciences and Education faculty collaboration on new middle grades licensure programs

Shadow courses are support courses taken concurrently with A & S courses by prospective teachers to introduce topics and discuss implications for instruction at the middle grades.

Inter-Institutional Collaboration

- Regional planning meetings for new licensure programs
- Co-sponsoring of institutes by the Southwest Ohio Regional Professional Development Center

The University of Cincinnati collaborated with Miami University in creating task force groups, including classroom teachers from Cincinnati Public and Middletown, to develop new programs for middle grades licensure. Sixteen teachers and representatives from the SWRPDC served on the advisory groups.

Institutes and Workshops for K-12 Teachers

- 5 Physical Science by Inquiry summer institutes co-sponsored with the SWRPDC
- Science institute conducted for middle school teachers to integrate technology into their curricula
- 4 science workshops offered by the Department of Microbiology to area teachers

Physical Science by Inquiry institutes have been offered for high school and middle school teachers in 1996, 1997, and 1998. A similar institute for primary teachers was offered in 1998 and 1999. The technology-focused institute involved 40 teachers from 8 districts. "Yeast Mutants as an Educational Tool" workshops, conducted by the medical school in 1997, 1998, 1999, and 2000, engaged Cincinnati Public School teachers in laboratory activities as part of an ongoing research project.

Professional Development for Higher Education Faculty

- Colloquium for faculty by national experts on middle grades mathematics and science learning

Twenty-three faculty from Arts & Sciences and Education met for a one-day colloquium with two national experts on middle-level mathematics and science to develop an image of what well-prepared middle level teachers look like in terms of knowledge, skills, attitudes, values, and background experiences. This preparation preceded task group work to develop proposals for new licensure programs.

SUSTAIN Focus at University of Cincinnati

- 1997-98: Used a collaborative approach with Arts & Sciences and Education faculty and area teachers to develop proposals for new middle childhood licensure programs for science and mathematics.
- 1998-99: Four new science content and four new "shadow courses" developed and field-tested; these courses introduce inquiry teaching, science-technology-society issues, and the history and nature of science to middle grades students.
- 1999-00: Conducted a two-week institute in Physical Science by Inquiry for 20 primary teachers from Southwest Ohio.

The inter-institutional collaboration between the University of Cincinnati and Miami University in the design of new middle grades licensure programs in science and mathematics has been a productive means of engaging Arts & Sciences and Education faculties both within and across institutions.

University of Cincinnati SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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Ohio's Systemic Initiative
Discovery

University of Toledo
Mathematics and Science Education Profile

Institution

- 16,400 undergraduate students
- 4,400 graduate students
- 600 faculty

The University of Toledo, founded in 1872, offers more than 140 programs of study across eight colleges.

Mathematics and Science Teacher Education

- 2 mathematics education faculty
- 2 science education faculty

Baccalaureate programs produce about 10 mathematics teachers and 20 science teachers (grades 7-12) each year. In five years, the number of mathematics and science education faculty has dropped from five and four full-time faculty, respectively.

Course Development and Revision

- 1 mathematics course for education majors being revised to incorporate inquiry
- 1 new mathematics course being created for middle childhood preservice teachers
- A series of new courses integrating mathematics, science, and technology for middle grades licensure

Course development and revision is currently being driven by new middle grades licensure requirements. Phase 3 of *SUSTAIN* funding is assisting institutionalization of inquiry approaches.

Intra-Institutional Collaboration

- Coursework for middle grades licensure
- Joint efforts in working with K-12 districts and teachers
- Cooperative programs with Lake Erie Center and Toledo Planetarium

Education and Arts & Sciences faculty have worked together extensively on institutes for teachers, Eisenhower and National Science Foundation projects, and proposals for meeting new licensure requirements. Tentative planning is underway to establish a collaboratively developed master's degree through the Colleges of Arts & Sciences and Education. The College of Education also collaborates extensively with the Colleges of Engineering, Health and Human Services, and Pharmacy, as well as with the former Community Technical College.

Inter-Institutional Collaboration

- Lourdes College
- Toledo COSI

A rich history of collaboration exists between faculty of UT and Bowling Green State University. Examples include state and federally funded institutes and projects, teaching, and credit-completion programs for undergraduate and graduate students. Extensive collaborations also occur on a variety of projects with Toledo Public Schools, Springfield Local Schools, Lourdes College, and Toledo COSI.

Institutes and Workshops for K-12 Teachers

- 3 *OSI-Discovery* institutes for teachers
- 1 institute for resource teachers

The University of Toledo has been a regional leader in science and mathematics education for many years, with numerous strong programs for districts, teachers, administrators, and others. Efforts include the SciMaTEC Center, a $5.2M National Science Foundation grant, and multiple Eisenhower projects, as well as leadership of inquiry-based, *Discovery* institutes for teachers and administrators.

Professional Development for Higher Education Faculty

- Arts & Sciences speaker series
- Workshop on licensure and Title II report cards

Numerous professional development opportunities for faculty are scheduled collaboratively across colleges, some on an ongoing basis, for example, the A & S speaker series that brings in nationally renowned speakers such as Sheila Tobias. Others include special-topic opportunities, such as fall workshops to outline implications of new teacher licensure requirements and Title II report card issues.

SUSTAIN Focus at University of Toledo

- 1997-98: Formed four teams of Toledo Public middle grades mathematics and science teachers and administrators for building-level action improvement teams.
- 1998-99: Sixteen UT preservice teachers added to original teams of 16 in-service teachers for inquiry mathematics and science summer institutes and action plan development; integrated inquiry teaching modules implemented in the fall through preservice and in-service teams.
- 2000-02: Two new inquiry-based courses integrating mathematics, science, and technology for middle grades teachers to be collaboratively developed by Arts & Sciences and Education faculties.

SUSTAIN activities began at The University of Toledo in 1997-98 with a school-based focus on inquiry institutes centered around school improvement and partnering preservice and in-service teachers. In Phase 3 the focus has shifted to development of new inquiry-based courses for middle grades licensure.

University of Toledo SUSTAIN Collaborative Directory

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Ohio's Systemic Initiative
Discovery

Wright State University
Mathematics and Science Education Profile

Institution

- 12,116 undergraduate students
- 689 faculty
- 2,962 master's students
- 624 doctoral/professional students

Wright State University, established in 1964, offers 148 degree programs across 9 colleges and schools.

Mathematics and Science Teacher Education

- 3 mathematics education faculty (1 in mathematics, 2 dual appointment mathematics/education)
- 6 science education faculty (2 in science, 4 dual appointment science/education)

Baccalaureate programs produce 10-15 mathematics teachers and about 20 science teachers (grades 7-12) each year. The number of students and faculty in mathematics and science education has remained fairly constant over the past five years.

Course Development and Revision

- 13 education courses developed/revised to meet new licensure requirements
- 24 new credit hours in each content area for middle grades licensure
- 8 mathematics courses revised to incorporate more inquiry
- 10 science courses revised to incorporate more inquiry

A new middle grades methods course has been developed, as well as 2 new mathematics courses and 4 new science courses especially designed for middle grades teachers; all are small, inquiry-based courses.

Course revisions include integration of science and mathematics, historical and social perspectives, applications and problem solving, authentic assessment, and pre/post knowledge/attitude measures.

Intra-Institutional Collaboration

- Dual appointments foster intradepartmental activities
- Other arts & sciences faculty actively participate in collaborative teacher education activities

Many faculty members, in part due to dual appointments in a content area department and in education, are interested in educational issues. Evidence of this interest is shown in the number of faculty members who have participated in course revisions, *Discovery* institutes, licensure program development, master's degree program development, grant proposals, and in-service programs for teachers.

Inter-Institutional Collaboration

- University of Dayton
- Central State University
- Clark State Community College
- Sinclair Community College
- Edison State College
- WSU, Lake Campus

Collaboration with these institutions has included one-day chautauquas and inquiry classroom visitations for science, mathematics, and education faculty. These events have laid the groundwork for collaborative partnerships in Phase 3 of *SUSTAIN*.

Institutes and Workshops for K-12 Teachers

- 12 teacher institutes
- 5 school districts

Faculty have conducted at least a dozen professional development programs in the past five years, including summer institutes for K-12 teachers in five local districts (Dayton Public, Trotwood-Madison, Fairborn, Huber Heights, and Springfield). All of these programs have included an administrator workshop.

Professional Development for Higher Education Faculty

- 2 *SUSTAIN* institutes
- 3 National Network for Educational Renewal institutes

Two workshops sponsored by *SUSTAIN* have been conducted for area college and university faculty in mathematics and science working to improve preservice teacher education. Three workshops focusing on school renewal and the education of educators have benefited faculty from WSU and partner institutions.

SUSTAIN Focus at Wright State University

- 1997-98: Faculty adopted inquiry model for institutional change; one administrative and five teacher institutes conducted with Dayton Public Schools.
- 1998-99: Seven core teacher education courses for elementary majors revised; six new inquiry courses for middle childhood licensure developed.
- 2000-02: Collaborating with regional community colleges and universities (Central State University, University of Dayton, Sinclair Community College, Edison Community College) to revise teacher education courses, conduct ongoing professional development for college faculty, and develop a technology dissemination network according to commonly shared standards.

Wright State University has taken a systemic approach to reforming elementary mathematics and science teacher education starting with its own institution and extending to the western Ohio region.

Wright State University SUSTAIN Collaborative Directory

Institution	*Primary Contact Information*	*SUSTAIN Team Members*	
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		Marlan Aldridge	*Physics*
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		Pat Klopfenstein	*Biology*
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Ohio's Statewide Initiative
Discovery

Youngstown State University
Mathematics and Science Education Profile

Institution

- 11,700 undergraduate students
- 1,150 graduate students
- 380 faculty

Youngstown State University, founded in 1908, offers more than 110 bachelor and associate degree programs across 7 colleges and schools. The master's degree is offered in 24 programs, and there is a doctoral program in educational leadership.

Mathematics and Science Teacher Education

- 7 part-time mathematics education faculty
- 8 part-time science education faculty

Baccalaureate programs produce about 12 mathematics teachers and 20 science teachers (grades 7-12) each year. The number of mathematics teachers has been fairly constant over the past ten years, varying from about 10 to 15. The number of science teachers has been steadily increasing to its present number.

Course Development and Revision

- Physics and astronomy introductory courses have been revised; mathematics and science education courses have included inquiry activities since 1996, reflecting YSU involvement with *Project Discovery*.
- Four new courses developed for middle grades licensure, three in mathematics and one in science
- Strands for new science courses are being developed through NSF- and Eisenhower-sponsored projects drawing upon highly regarded and tested national programs such as Constructing Physics Understanding.

Youngstown State recently converted from a quarter system to a semester system. This conversion incorporated changes arising from a new general education model for all undergraduate programs.

Intra-Institutional Collaboration

- Arts & Sciences and Education faculty participate in NSF grant projects and Eisenhower projects.
- The NSF SMET grant project is developing inquiry-based laboratory courses involving faculty from two or more sciences in each course.

Informal collaborations between Arts & Sciences and Education have been extended and institutionalized through *SUSTAIN* and leadership of the deans of Education and Arts & Sciences. These efforts have led to a five-year Teacher Education Enhancement grant from the US Department of Education Title II program.

Inter-Institutional Collaboration

- Annual stakeholders' meeting
- Spring meeting with business leaders

Youngstown State holds stakeholders' meetings among faculty, Youngstown and Warren City Schools, Trumbull and Mahoning County Educational Service Centers, and the Far East Region Professional Development Center to provide input on undergraduate education programs for mathematics, science, and language arts teachers. Representatives of the business community have lent support to reform efforts.

Institutes and Workshops for K-12 Teachers

- 10 institutes for teachers (3 academic year *Discovery*-Cascade, 4 mathematics, and 3 physical science)
- 1 *Discovery* institute for principals, involving 55 administrators from the Youngstown City Schools

The director of student teaching has committed to placing participating institute teachers with in-service teacher partners to provide classroom experience ideally suited to use of inquiry-based methods. Institutes have occurred through *SUSTAIN* and a Title II Partnership grant.

Professional Development for Higher Education Faculty

Youngstown State faculty have formed professional development and teaching support groups, such as the collaborative learning discussion group, and a network of teaching circles on alternative assessment, teaching with technology, and the scholarship of teaching and learning. A Scholarship of Teaching and Learning Symposium is planned for 2001. A Faculty-In-Residence program enables mathematics, science, and language arts faculty to work at least half-time during the academic year in partner schools.

SUSTAIN Focus at Youngstown State University

- 1997-98: A five-week mathematics institute and a three-week science institute for middle school teachers, integrating content and inquiry pedagogy, team-taught by Arts & Sciences and Education faculty with a clinical *Discovery*-trained teacher.
- 1998-99: Two inquiry institutes, one in mathematics and one in science, offered to preservice and in-service teachers, paired for follow-up student teaching with in-service partners.

Youngstown State University uses input from regional K-12 faculty and administrators to assess needs, make recommendations, and devise implementation strategies for inquiry-rich licensure programs developed collaboratively by Arts & Sciences and Education faculty. The five-year Title II grant will enhance institutionalization of *SUSTAIN* objectives, including joint curricular planning, cross-appointment of faculty, and collaborative outreach to area schools.

Youngstown State University SUSTAIN Collaborative Directory

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